

Sensitivity of cirrus properties to ice nuclei abundance

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The relative importance of heterogeneous and homogeneous ice nucleation for cirrus formation remains an active area of debate in the cloud physics community. From a theoretical perspective, a number of modeling studies have investigated the sensitivity of ice number concentration to the nucleation mechanism and the abundance of ice nuclei. However, these studies typically only addressed ice concentration immediately after ice nucleation. Recent modeling work has shown that the high ice concentrations produced by homogeneous freezing may not persist very long, which is consistent with the low frequency of occurrence of high ice concentrations indicated by cirrus measurements. Here, I use idealized simulations to investigate the impact of ice nucleation mechanism and ice nuclei abundance on the full lifecycle of cirrus clouds. The primary modeling framework used includes different modes of ice nucleation, deposition growth/sublimation, aggregation, sedimentation, and radiation. A limited number of cloud-resolving simulations that treat radiation/dynamics interactions will also be presented. I will show that for typical synoptic situations with mesoscale waves present, the time-averaged cirrus ice crystal size distributions and bulk cloud properties are less sensitive to ice nucleation processes than might be expected from the earlier simple ice nucleation calculations. I will evaluate the magnitude of the ice nuclei impact on cirrus for a range of temperatures and mesoscale wave specifications, and I will discuss the implications for cirrus aerosol indirect effects in general.